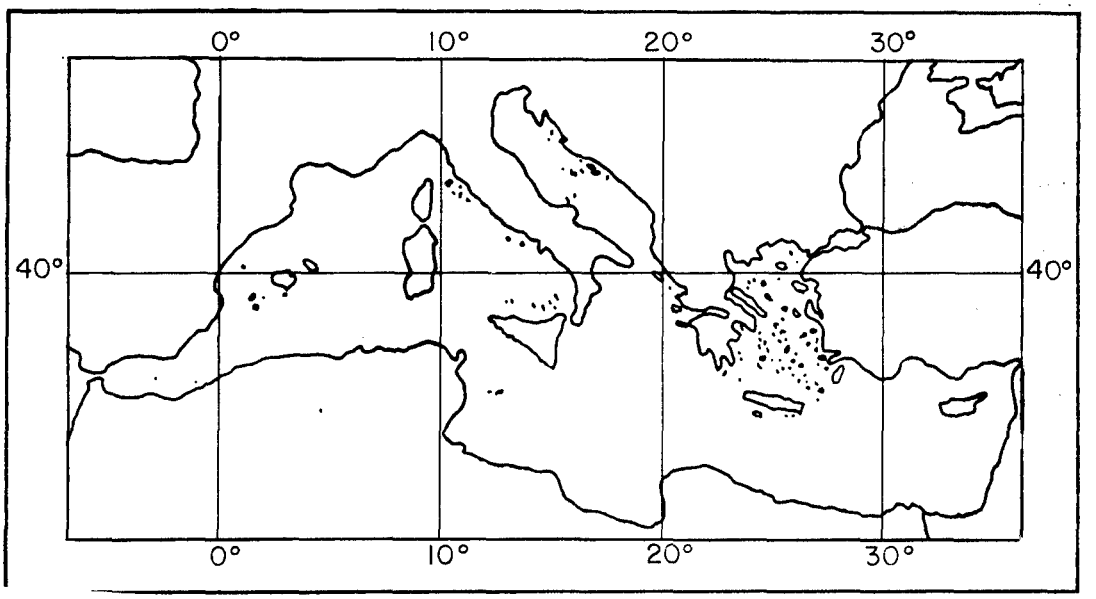
IR No. 70-30

INFORMAL REPORT

PLANKTON DISTRIBUTION IN THE MEDITERRANEAN SEA 1962-1963



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NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D. C. 20390

INFORMAL REPORT

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ABSTRACT

Naval Oceanographic Office ships collected 34 plankton samples in the Mediterranean between 6 July 1962 and 24 August 1963. Species composition was quite similar throughout the sea. Ninety-four genera of plankters were identified from the western sector and 84 genera from the eastern sector. Seven of 11 major taxa were two to ten times more numerous in the western portion of the sea and only two of these taxa proved more numerous in the eastern portion. About 20 percent of the forms listed were bioluminescent. Many plankters enter the Mediterranean from the Atlantic through the Strait of Gibraltar and are swept eastward by the prevailing currents, becoming progressively scarcer towards the eastern sector of the sea.

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This report has been reviewed and is approved for release as an UNCLASSIFIED Informal Report.

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ACKNOWLEDGEMENT

The writer wishes to thank Dr. Thomas E. Bowman of the Smithsonian Institution and Prof. V. Moncharmant of the Naples Zoological Station who rendered generous assistance in the identification of crustaceans and larval fishes, respectively.

Mr. Richard Wright of the Naval Oceanographic Office sorted four of these samples, the remainder were sorted and analyzed by the writer.

TABLE OF CONTENTS

FIGURES

TABLES

I. INTRODUCTION

In recent years, the U.S. Navy has become increasingly interested in the seasonal distribution and density of marine plankton. Swarms of plankters are known to form scattering layers which produce false bottom signals. These prematurely reflected signals are caused by horizontal bands of organisms; either nektonic, planktonic, or both.

Another feature observed in certain species of plankton is bioluminescence. Marine bioluminescence is commonly classified into three types: 1) sheet, 2) sparkling, and 3) glowing sphere. In high concentrations, these plankton produce bioluminescence of military significance. At present, no data are available that would correlate the abundance index of any of these animals with the approximate threshold of significant bioluminescence.

Some planktonic forms, notably Chaetognatha, are so dependent on a constant range of salinity and water temperature that they are virtually confined to a single water mass. These plankters are known as indicator species and have been used as a convenient method of tracing the origin of various water masses in the oceans.

In 1962 and 1963, the U.S. Naval Oceanographic Office (NAVOCEANO) conducted cruises in the Mediterranean Sea. Samples were collected to determine the distribution and density of marine plankton. In the western Mediterranean Sea (Fig. 1), Navy ships collected 26 samples from 23 stations. A previous publication has reported on the data from the six plankton tows made in the Tyrrhenian Sea (Bruce, 1968). In the eastern Mediterranean (Fig. 2), 18 plankton samples were collected at 15 stations.

The samples were preserved aboard ship, using a 4% formaldehyde solution, and then stored in pint jars. Laboratory examination (at NAVOCEANO) was with a binocular and/or compound microscope. Portions of the sample were diluted and placed in a counting cell and sub-samples were removed with a Stempel pipette. A sufficient number of sub-samples were extracted to permit the count of about 1000 plankters. In samples containing less than 1000 plankters (also sample #1160) all specimens were counted. These counts were used as a basis for determining the relative abundance of the various taxa. The results are qualitative rather than quantitative because the water volumes filtered through the plankton nets were not measured; however, sufficient data were obtained to indicate concentrations of the more numerous taxa.

II. PLANKTON IN THE WESTERN MEDITERRANEAN

Tables I and II provide a summary of the station data in the western Mediterranean.

Protozoa

In the western Mediterranean, 20.7% of plankton counted were dinoflagellata of four bioluminescent genera: Ceratium, Peridinium, Pyrocystis, and Noctilucca. These forms were numerous west of Sicily, off Naples, and along the Algerian coast (Fig. 3). Dinoflagellata were numerous in most tows made with a #10 mesh net, but many were apparently too small to be caught in the #5 mesh net used at several stations.

Coelenterata

Jelly fish and Nectophores composed 17.2% by count of all plankters. Siphonophora (Fig. 4) showed areas of concentration off the Corsican coast in spring (Sta. 980) and in the western Mediterranean in summer (Stas. 24 and 1160). Hydrozoa, composing 1.9% of the plankton, were concentrated in nearshore Algerian waters and became numerous in late summer off the southeast coast of Spain (Fig. 5).

Arthropoda

Copepoda, consisting of 41 taxa, composed 31.6% of all plankters (Fig. 6). Most of the Copepoda were observed off the eastern Spanish coast and off the west coast of Sicily during early July. Calanus was the most numerous genus, being represented by several species. Clausocalanus (specifically C. arcuicornis) was the second most numerous genus. Centropages (specifically C. typicus) was wide spread and ranked third in numbers. The following bioluminescent Copepoda genera were also obtained: Corycaeus, Euchaeta, Lucicutia, Oncaea, Pontella, and Pleuromamma.

Euphausiids were numerous at stations off the coast of Algeria in winter sampling. These Euphausiids were bioluminescent and composed 4.3% of all plankters (Fig. 8). Amphipoda were collected at 14 stations and composed 0.5% of the plankters. Ostracods were scarce and were confined to the portion of the sea between the Algerian coast and Sardinia in winter and off Naples in October (Fig. 7). Decapod larvae swarmed in August off the northeast coast of Algeria and were widely distributed.

Mollusca

Bivalve larvae were scarce, but pteropods were numerous (Fig. 9). Small numbers of the heteropod, Atlanta sp., occurred at ten stations.

Chaetognatha

Arrow worms were numerous in winter in a limited area chiefly along the Algerian coast, with concentrations extending at least 75 miles seaward (Fig. 10). Arrow worms also were numerous in late summer and fall at stations along the coasts of Spain and Naples.

Urochordata (Tunicates)

Bioluminescent Salpa sp. and Larvacea were collected at most stations. Maximum numbers were taken along the Algerian coast and in the nearshore waters off the east coast of Spain (Fig. 11).

Fish larvae of several species were somewhat less numerous than fish ova in these samples; both combined totalled 0.1% of the plankters.

III. PLANKTON IN THE EASTERN MEDITERRANEAN

Tables III and IV provide a summary of the station data in the eastern Mediterranean.

Protozoa

In the eastern Mediterranean, four areas contained concentrations of dinoflagellates: 1) in the NE currents setting between Cyprus and the Latakin coast (Stations 673 and 695), 2) along the convergence of the NE-NW currents approximately over the 1000 fathom line westward from Lebanon (Fig. 12), 3) in the Aegean and Sea of Crete, and 4) off the NW coast of Egypt (Sta. 1241). The densest swarms occurred in the Aegean and Sea of Crete in January and off the Egyptian coast in the fall. Dinoflagellates composed 19.7% of the plankton collected from all eastern sectors. Two genera were dominant and both bioluminescent, Pyrocystis and Ceratium.

Coelenterata

Several species of Siphonophores are known to be bioluminescent. Those forms were most numerous in the northeast drift current south of Cyprus in a zone extending from Lebanon NE to the straits east of Cyprus (Fig. 13). Bioluminescent Medusae were quite numerous east of Cyprus (Fig. 14).

Arthropoda

Copepoda constituted 12.5% of the plankton with the most numerous species being Oithona sp. Calanus sp. and closely related forms were second in abundance. A decrease in the number of observed genera in the east indicates a less varied fauna than in the western basin. Copepods were present at all stations, however, they were concentrated east of Cyprus, in the Sea of Crete, and in the convergence of the NE-SW currents (Stas. 585 & 586) as shown in Figure 15.

Euphausiids, a group of mostly bioluminescent members, were present in small numbers at most stations. Mysids, also bioluminescent and totalling 0.6% of the plankton, were essentially confined to deeper portions of the NE drift south of Cyprus and were scarce in coastal waters. Amphipods and the bioluminescent Cladocera genera Evadna sp. and Podon sp. were minor components of the plankton.

Mollusca

Planktonic molluscs (pteropods) composed 3.5% of the total plankters and were numerous at most stations. Swarming occurred at the mid-channel station between Cyprus and the mainland. Limacina was the most numerous genus (Fig. 16).

Chaetognatha

Arrow worms were scarce in all samples collected in the eastern Mediterranean, composing only 0.5% of all plankton.

Echinodermata

Larval starfish and sea urchins were numerous south of Cyprus and relatively common at most stations, making up 2.7% of the total plankton (Fig. 17).

Urochordata (Tunicates)

Specimens of Salpa sp. were collected chiefly at the eastern edge of the deep water basin west of Syria and Lebanon. Salpa sp., which totalled less than 0.4% of the plankton, contributes significant bioluminescence because of their relatively large size. Larvacea, small in size but reputedly bioluminescent, were concentrated around eastern Cyprus, in the Sea of Crete (July), and in the channel west of Syria (Fig. 18).

IV. SUMMARY

A comparison of the plankters based on these data shows that seven major planktonic taxa are from two to ten times more numerous in the western portion than in the eastern portion of the Mediterranean. Most of the major taxa may be considered to be typical Atlantic forms. The permanent western Mediterranean plankton populations are assumed to be augmented by the arrival of identical forms from the Atlantic.

In the eastern Mediterranean, only two major planktonic taxa were more numerous than in the western Mediterranean. The southeastern genera are best adapted to withstand the higher salinity and warmer water temperatures which prevail during much of the year (Sverdrup, Johnson, Fleming 1942).

V. PRACTICAL APPLICATIONS

Data pertaining to the intensity of bioluminescent display at the time of sample collection are not available. A literature search by Staples (1966) concluded that the western basin of the Mediterranean has strong milky bioluminescence periodically from October through June. The data in this report confirms this conclusion by showing concentrations of Ceratium sp. and Noctilucca sp. in the western

basin of the Mediterranean and in the Alboran Sea in spring and fall (Fig. 3). Staples also reported that swarms of Euphausiids produced spark-like displays in winter along the French and Italian coasts. NAVOCEANO data indicate the probability of similar Euphausiid displays north of the Algerian coast in winter (Fig. 8). Staples also mentions glowing-ball displays of Medusae in the western Mediterranean. Concentrations of Medusae (summer and spring of 1962) observed along the Spanish coast doubtless produced such displays (Fig. 5). Euphausiids, Ostracoda, and the Copepod genera Corycaeus, Oncaea, and Pleuromamma seemed to have been in sufficient numbers in October 1962 along the approaches to the Gulf of Naples to have caused limited spark-type bioluminescence. Probably Ceratium sp. and Pyrocystis sp. occurred in sufficient concentration in the Gulf of Naples to have caused significant milky water displays.

Relatively little is known of bioluminescence in the eastern Mediterranean Sea. The concentrations of Peridineum sp. and Ceratium sp., observed in January and July in the southern Aegean Sea and Sea of Crete, suggest the presence of milky type luminescence in those months; likewise, milky bioluminescence probably occurred along the Palestine and Syrian coasts in the fall months (1962). Little evidence exists to indicate either sparkling or glowing-ball displays in the eastern basin in the fall months.

Recent authorities on scattering layers agree on their biological origin and designate their chief components as probably Euphausiids, Siphonophores, and Myctophid fishes. Backus (Backus, et al. 1968) has recently described a scattering layer effect in which a Myctophid (Pisces: Ceratoscopelus sp.), common in the Mediterranean, was identified by repeated submarine observations with discrete hyperbolic echo-sequences. Thus, an abundance of these forms may be associated with a scattering layer effect. A weak but well developed scattering layer showing diurnal migration throughout the Mediterranean (Frassetto and Croce, 1965) coincides with the greatest concentration of plankton collected on the NAVOCEANO cruises. The intensity of scattering layer decreases in the Mediterranean eastward as does the density of plankton.

VI. ADDITIONAL WORK NEEDED IN THE AREA

Nekton, phytoplankton, and zooplankton are interdependent, so that to obtain the proper perspective, the relationship of all must be studied to understand the status of any of the component members. If scattering layer effect and bioluminescence in the Mediterranean Sea are to be understood, the plankton and nekton should be sampled every three months over a three year period, at the stations indicated in Figure 19.

The collections could be made with an 80-foot ketch (60 gross tons). Observations should be made with a 10-foot mid-water trawl (Cod end #0 mesh nylon) combined with tandem plankton nets of #8 and #20 mesh mounted on 1 meter rings. The water column should be

determined by a flow meter on each net during an oblique tow from 150 fathoms to the surface at a net speed of 2 knots. Each net system should include a bioluminescence photometer capable of a constant telemetric record of the light intensity at net level during each tow. A complete echograph record of each cruise should be made, and physical oceanographic data, including nutrients, should be collected at each station. Figure 19 indicates the division of labor by sections for nine vessels working simultaneously to complete the task in 5 to 7 days per season per year to provide the synoptic data required for effective seasonal comparison.

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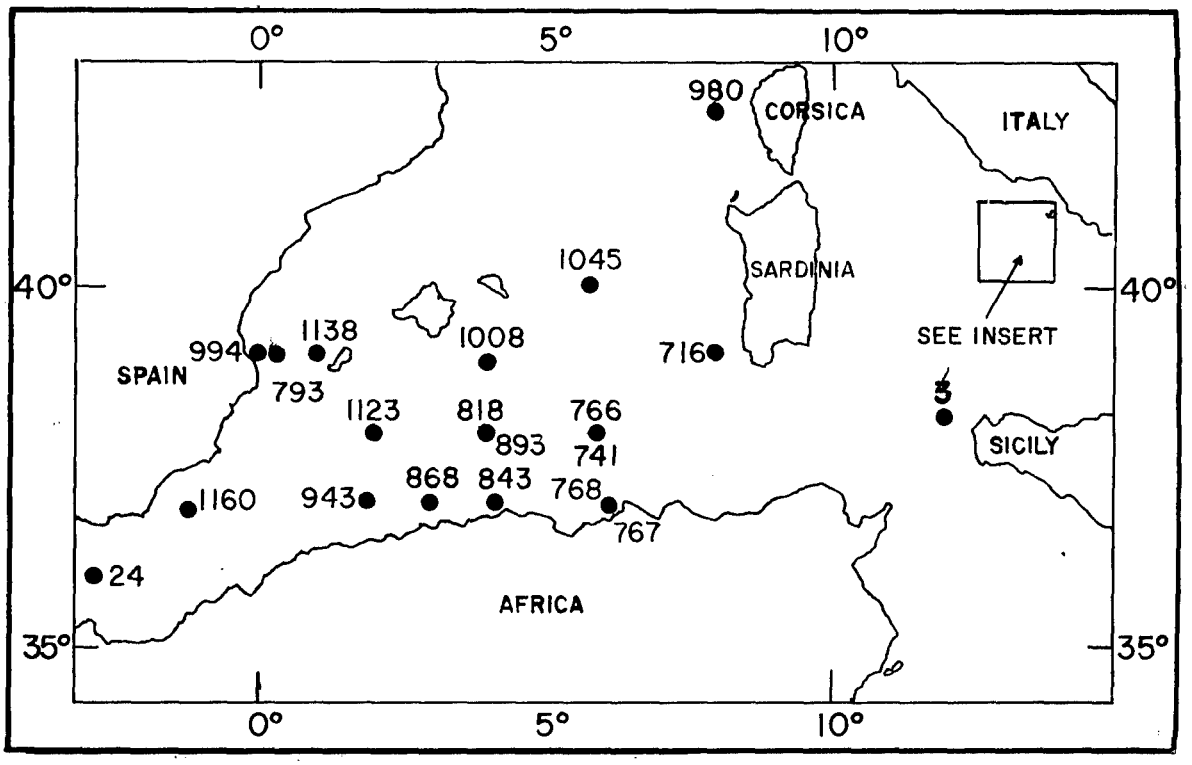

Figure 1. Location of Plankton Sample Stations in the Western Mediterranean Sea

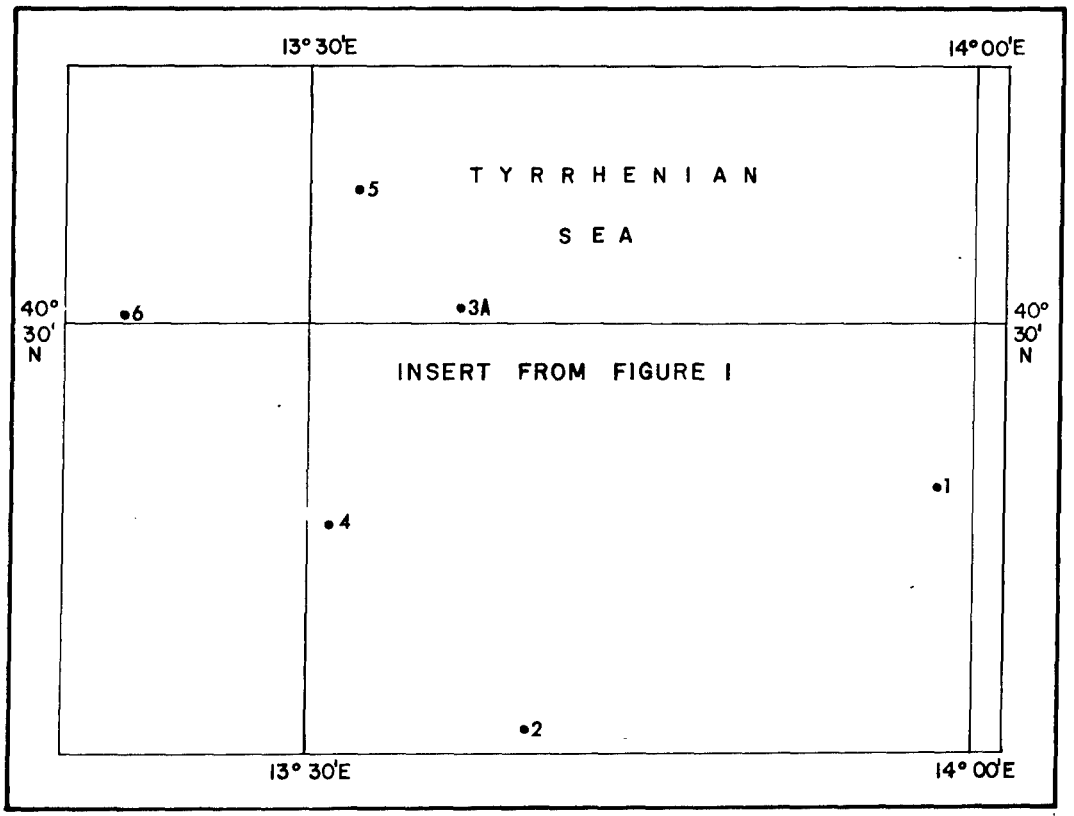

Table I. Station Data for Plankton Samples – Western Mediterranean

Sample No	Date (1962)	Latitude	Longitude	Time of Tow (GMT)	Duration of Tow (Hours)	Depth of Tow (ft)	Type of Tow	Mesh #	Water Temp (°F)
1	Oct 16	40°24'N	13°58' E	1600	0.25	100	obliq	0	64.6
2	Oct 16	40°16'	13°40'	2000	0.42	90	obliq	0	71.8
3	Jul 9	38°00'	12°00'	1800	0.50	175	vert	-	-
3A	Oct 16	40°30'	13°36'	2400	0.33	90	obliq	0	71.0
4	Oct 17	40°23'	13°31'	0400	0.17	90	obliq	0	61.5
5	Oct 17	40°34'	13°32'	0800	0.17	140	obliq	0	65.8
6	Oct 17	40°30'	13°22'	1200	0.33	100	obliq	0	70.8
24	Oct 8	36°00'	03°00' W	0800	2.00	0	horiz	5	74.0
	(1963)								
716	Jan 9	39°00'	08°00' E	1100	0.50	130	horiz	5	57.0
741	Jan 27	38°00'	06°00'	0330	1.00	0	horiz	5	58.4
766	Jan 29	38°00'	06°00'	1130	1.00	0	horiz	-	58.2
767	Jan 31	37°00'	06°00'	2015	0.25	164	vert	0	52.0
768	Jan 31	37°00'	06°00'	2000	0.50	656	vert	0	52.0
793	Feb 9	39°00'	00°08'	0100	1.00	0	horiz	0	55.4
818	Feb 26	38°00'	04°00'	2200	1.00	0	horiz	0	56.7
843	Mar 1	37°00'	04°00'	2000	1.00	0	horiz	0	56.8
868	Mar 4	37°00'	03°00'	2200	0.50	0	horiz	5	57.6
893	Mar 6	38°00'	04°00'	2200.	1.00	0	horiz	5	57.3
943	May 2	37°00'	02°00'	1300	1.00	0	horiz	5	62.6
980	May 24	42°00'	08°00'	1100	1.00	0	horiz	5	62.1
994	Jun 18	39°00'	00°00'	0935	1.00	0	horiz	5	-
1008	Jun 23	39°00'	04°00'	0830	1.25	0	horiz	5	-
1045	Jun 28	40°00'	06°00'	0830	1.00	0	horiz	5	-
1123	Jul 9	38°00'	02°00'	2030	1.00	0	horiz	5	-
1138	Aug 14	39°00'	01°00'	1915	1.00	0	horiz	0	-
1160	Aug 24	37°00'	01°00' W	1900	0.75	0	horiz	0	77.0

Table II. Concentration of Observed Genera - Western Mediterranean

STA. NO.	1	2	3	3A	4	5	6	24	716	741	766	767	768	793	818	843	868	893	943	930	994	1008	1045	1123	1160	TOTAL
CHRYSOPHYTA (unidentified spp.)	18																									
Coscinodiscus sp.				1			1	2											10		22					50
Dinophysis sp.			7																							4
Rhizosolenia sp.	5						5										43					1				7
PROTOZOA																										54
Dinoflagellata																										
* Ceratium sp.	298	301	58	97	84	353	285	550	40	50		1					205	5	860	89	388	33	7	34		3738
* Noctilucca sp.			290		1		29										115	89	630			1				835
* Peridinium sp.																	1				1					322
* Pyrocystis elegans										2																2
* Pyrocystis sp.	103	39	18	51	54	29	14	18		50							8	22	3	5	23	6				443
Foraminifera																										
Globigerina sp.	10	10		9	8	10	21			3	1						9	1	1	8						91
Radiolaria(Unidentified sp.)	2	3	9				3		3	3				1					2					4		30
Nephrospirus sp.			2																							2
Tintinnida																										
Tintinnus sp.																	3		14	4	2					23
COELENTERATA																										
Hydrozoa (unidentified spp.)	66	12	2	3			2		1		19	11	2	2			2	6	2		132			11	215	488
Narcomedusae													1													
Solmundella sp.	2																									3
Siphonophora																										
* Abylopsis sp.				1						9	62	26		2	7	5	33	5	2	4	9	3				168
* Agalma sp.															4	14	17									35
Muggiaea sp.									3		50	18	11			11	70	13		900	8	12	56			1152
Physonectes sp.											7		1													8
Unidentified sp.	21	11	1	19	10	12	6	244						2			68		11		2			147	3000	3554
Trachymedusae																										
Aglantha sp.	12	10		13	1	2	1										2			1						42
Anthozoa																										
Zoantharia																										
Corianthus sp.																1										1
PLATYHELMINTHES																										
Turbellaria sp.																					1					1
ANNELIDA																										
Polychaeta (unidentified sp.)	2	3	10	5	9		4	1	5	2	5	7	7	1	7	1		1								70
* Tomopteris sp.		2		2	2							2														8
ARTHROPODA																										
Crustacea																										
Branchipoda																										
Evadne sp.	14	11	26	5	8	31	25	2										1	20	1	9	2		14		169
Podon sp.																					3					3
Cirripedia (larvae)			2								1															3
Balanus sp.				1																						1
Ostracoda																										
* Conchecia sp.		18		21	17	2	1		26	20	3	5	19													132
Copepoda																										
Acartia sp.	111	71		162	144	77	10		5			2		5						1				36		624
Acrocalanus sp.	1													16		294		16								17
Anomalocera pattersonii																										
Calanus gracilis	1	7		2	1		1				1	7			62											310
Calanus helgolandicus																										20
Calanus minor					62																					62
Calanus tenuicornis		8					4																			62
																										12

STA. NO.	1	2	3	3A	4	5	6	24	716	741	766	767	768	793	818	843	868	893	943	980	994	1008	1045	1123	1138	1160	TOTAL
Calanus sp.	37	78	1	81	1	6	48		35	97	250			665				1	2			3					1305
Calocalanus pavo												2															2
Candacia sp.											4	13	16			2											35
Calocalanus plumosa															5												5
Calocalanus sp.	27	67		79	53	21	17																				264
Centropages typicus	1	7		14	20	5	2		23					184	110	6	1	294		1	6						674
Centropages violaceous															17												17
Clausocalanus arcuicornis															326	20	43	302	4			3					698
Clausocalanus furcatus										3																	3
Clytemnestra sp.				1	3		5															3					12
Copilia sp.	2	1	1			1					1	2		1													9
* Corycaeus sp.	17	12	5	19	106	11	7		10	26		2	4	1			1	15									236
Eucalanus elongatus									6	3	1			1	5												16
* Euchaeta marina										4	12	16															32
* Euchaeta sp.		1		1																							2
Euchirella messinensis													3														3
Farranula sp.										3				1				1									5
Haloptilus sp.						2				1																	3
Heterorhabdus papilliger										6																	6
Lubbockia sp.		2																									2
* Lucicutia flavicornis		13		7					2	6																	28
Macrosetella sp.				2																							2
Mecynocera clausii	10	7		11	3	3	4		3	7																	48
Microsetella sp.				13		1	4													2							20
Oithona sp.	113	62	91	60	84	93	56			17		2					1	21	4			3	1				608
* Oncaea sp.	2	3	2	6	11	2	6		1	20							2	5			3						63
Pachos punctatum		2																									2
Phaenna spinifera											10						1										11
* Pleuromamma abdominalis										20	63	74	56	2	3		1										219
* Pleuromamma sp.	1	21		5																							27
* Pontella atlantica					1											1											2
Pontellopsis regalis		1																									1
Pontellopsis sp.													1														1
Rhincalanus nasutes													1														1
Sapphirina sp.	1	3		4	4	7			1	2	7	1	2														32
Scolecithrix danae													8			4											12
Temora stylifera	94	12		59	67	30	1			38	6			1	4	5		5									322
Copepoda larvae		1	605	2		30	206	2	11													3					860
Copepoda sp.	6	10	175	69	17	10	34	15		42	4	1	116	31	17	520	29	65	3		22	9	46		7	225	1473
Mallacostraca																											
Amphipoda (unidentified spp.)				2	4	1					8	6	5	3		23		1		1	6			11	2	33	106
Decapoda (larvae)			2						8	3	6	7		2		2		2						25	17	1575	1649
Lucifer sp.				2	5	2				1																	10
Maia sp.														2		5		1									8
* Sergestes sp.	1	1		1	2			2	9	1	1	1	2				2	1			1		1				26
Unidentified spp.	2	1				16	9				1					9		1				1					40
* Euphausiacea (unidentified sp	1	6		11	3	1				14	468	83	50	73	149	16	18	31			1			3		37	1114

STA. NO.	1	2	3	3A	4	5	6	24	716	741	766	767	768	793	818	843	868	893	943	994	1008	1045	1123	1138	1160	TOTAL
MOLLUSCA																										
Gastropoda																										
Heteropoda																										
Atlanta sp.	1	2		13	10	13		4		1	1	2				1										48
Pteropoda (unidentified spp.)			14							11	27	24	3	1			9	47	1	64	2		190	8	126	518
Creseis sp.	3	41		109	81	34	17	5	1		2	2	2			4		6								316
Hyalocylus sp.				3			1																			4
Lamellobranchiata(unidentified sp.)			1	1		1	2	1									23	2		2	1					34
CHAETOGNATHA (unidentified spp.)	15	33	9	5	24	78	43	55		77	56	56	121				3	3		7	5	2	7	83	682	1364
ECTOPROCTA (Cyphonautes larvae)							1																			2
PHORONIDEA (Phoronis larvae)							1																			1
ECHINODERMATA																										
Auricularian larvae							2																			2
Echinopluteus larvae	1	30			22	45	21																			119
Pluteus larvae								1	2		1	1						1		1			2	15	57	81
PROTOCHORDATA																										
* Larvacea (unidentified spp.)	61	12	6	13	18		19	23		1		8					10	2		14						100
Thaliacea																										
* Salpa sp.		1		6		7		1		1	4	10	5	11	1	78	16	1		83	2			18	160	405
* Doliolum sp.		5		4	12	14	1	1		1	4		7			25	15	1		10						81
* Pyrosoma sp.											1			1												2
Hemichordata																										
Tornaria larvae													1				1									2
CHORDATA																										
Pisces																										
Clupea pilchardus										5																5
Scomberesox saurus										1	1															2
Sygnathus phlegon																						2				2
Unidentified larvae		1	1		1	2							2				3						5	1	15	31
Unidentified ova			1	2	1			6			2	1			4	12	17	16			2			3	8	75
* BIOLUMINESCENT WHEN AGITATED																										

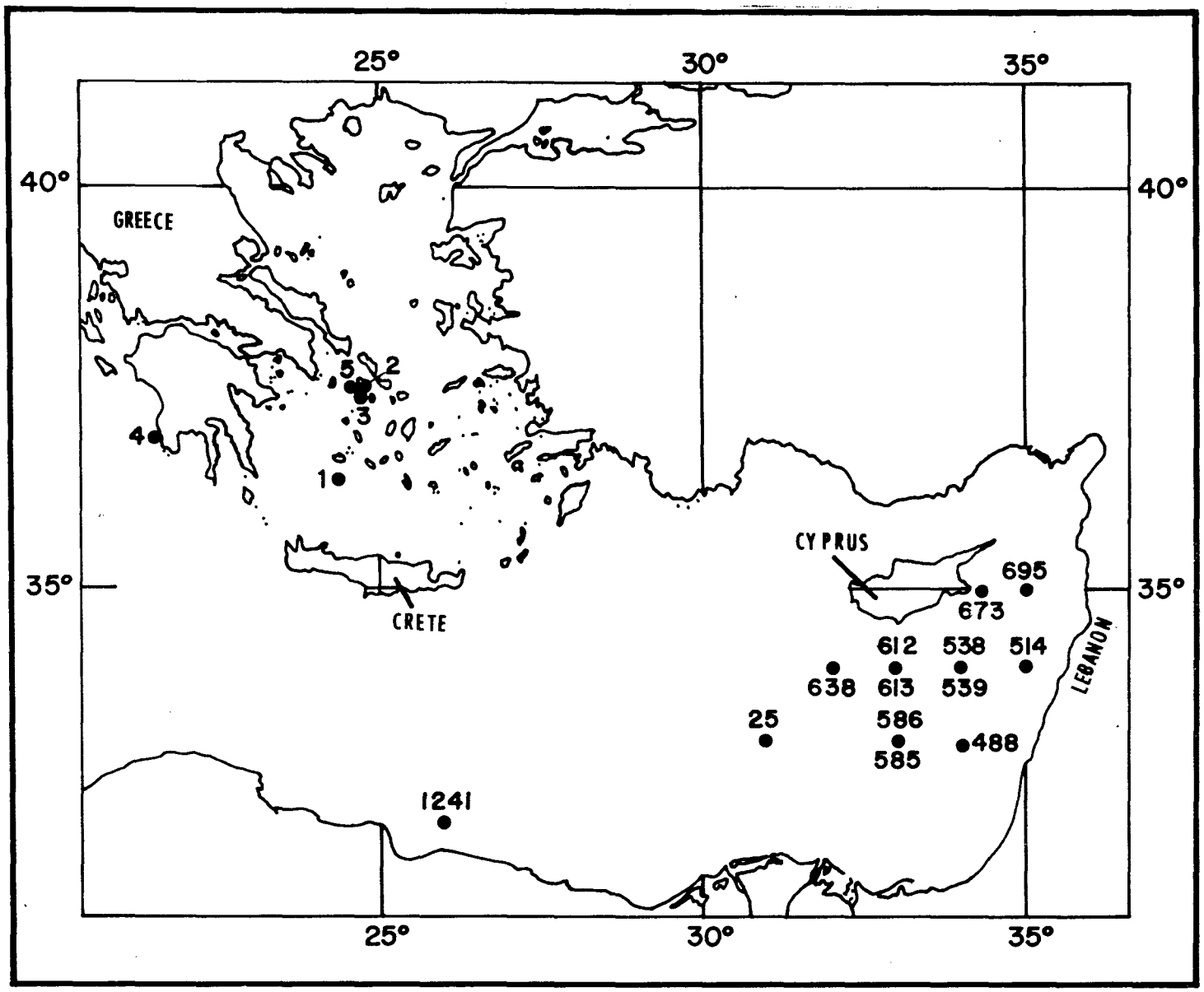

Figure 2. Location of Plankton Sample Stations in the Eastern Mediterranean Sea

Table III. Station Data for Plankton Samples-Eastern Mediterranean

Sample #	Date (1962)	Latitude	Longitude	Time of Tow (GMT)	Duration of Tow (Hours)	Depth of Tow (ft)	Type of Tow	Mesh #	Water Temp (°F)
2	Jan 6	37°33'	24°43'E	1515	0.8	30	horiz	20	57.6
3	Jan 6	37°32'	24°43'	1800	0.3	3	horiz	20	57.9
5	Jan 6	37°33'	24°34'	1245	0.3	120	vert	20	59.9
4	Jan 13	34°56'	21°41'	1300	1.0	6	horiz	20	62.6
1	Jul 6	36°23'	24°27'	1330	0.5	0	horiz	-	78.0
25	Oct 22	33°00'	31°00'	1930	1.5	-	-	5	78.0
488	Nov 10	33°00'	34°00'	2300	0.5	0	horiz	-	76.5
514	Nov 12	34°00'	35°00'	2100	0.5	984	vert	-	59.4
538	Nov 14	34°00'	34°00'	0000	0.5	0	horiz	-	75.4
539	Nov 14	34°00'	34°00'	0105	0.6	1640	vert	-	57.4
585	Nov 20	33°00'	33°00'	2330	0.5	-	horiz	0	74.6
586	Nov 20	33°00'	33°00'	2330	1.0	-	horiz	5	74.6
612	Nov 22	34°00'	33°00'	2130	1.0	0	horiz	0	74.3
613	Nov 22	34°00'	33°00'	2130	1.0	-	horiz	5	74.3
638	Dec 2	34°00'	32°00'	2300	1.0	0	horiz	5	73.0
673	Dec 10	35°00'	34°00'	2230	0.5	0	horiz	5	68.9
695	Dec 13	35°00	35°00'	2230	1.0	0	horiz	5	68.0
	(1963)								
1241	Oct 9	32°00'	26°00'	1015	0.5	0	horiz	-	78.8

Table IV. Concentration of Observed Genera - Eastern Mediterranean

STA. NO.	1	2	3	4	5	25	488	514	538	539	585	586	612	613	638	673	695	1241	TOTAL
CHRYSOPHYTA																			
Chaetoceros sp.		44	13																57
Enteromorpha sp.						14													14
Rhizosolenia sp.		267	103	1	240	1								1		2	3		618
Thallassioseira sp.					7														7
Thallassiothrix sp.		404	261		515														1180
PROTOZOA																			
Dinoflagellata																			
* Ceratium sp.	17	104	261	11	77	54	70						6	89	5	122	132	9	957
* Dinophysis sp.	2	8	17		19														46
* Peridinium sp.	686	3	35	1	3														728
* Pyrocystis elegans													13	22					35
* Pyrocystis noctilucca	1		3	4	2	56	342	28		12	12	98	44	22	5	82	104	1100	1915
Foraminifera																			
Globigerina sp.			12	10			2				8	4	18		1	49	64	72	240
Radiolaria (unidentified sp.)	1	7	2		2	20	11	1					2	18	1	5	5		75
COELENTERATA																			
Hydrozoa																			
Narcomedusae (unidentified sp.)						6	5			1	24	3	17	3	1	50	18	1	129
Solmundella sp.											3	2	4	3		3	1		16
Siphonophora (unidentified sp.)						5	22	31	1	3	94	26	53	3	2	16	30	27	313
Abylopsis sp.							24	21			17	20				22	30		134
Anthozoa																			
Zoantharia																			
Corianthus sp.								1				1	3			7	1		13
* Scyphozoa (unidentified sp.)		1																	1
ANNELIDA																			
Polychaeta (unidentified larvae)	7						1	1		1			1		1	9			21
Tomopteris sp.								4		1	1					1	1		8
ARTHROPODA																			
Crustacea																			
Branchipoda (Cladocera)																			
Evadne sp.	24						1							5		9	1		40
Podon sp.							1			1	1	2						4	9
Cirripedia																			
Balanus sp.				3															3
Lepas sp. (larvae)	2																		2
Copepoda																			
Acartia sp.						6				3		2				3	22		36
Calanus gracilis								1					2				3		6

STA. NO.	1	2	3	4	5	25	488	514	538	539	585	586	612	613	638	673	695	1241	TOTAL
Calanus sp.								12				73					77		162
Calocalanus sp.		1	2									4		1		2	7		17
Candacia bispinosa										1									1
Candacia simplex								5											5
Clytemnestra sp.			3	1	2														6
Copilia sp.								2					2			1			5
* Corycaeus sp			1	1	5	2	5				1	21	1	3	1	17	16		74
* Euchaeta marina								6			4	5	1			1	5		22
Euchirella messinensis												3							3
Farranula sp.			1													8	24		33
Halopitilus sp.								45		15									60
Heterorhabdus papilliger									1										1
Labidocera sp.						4		1											5
Lubbockia sp.																2			2
* Lucicutia flavicornis														2			1		3
* Lucicutia longicornis					4														4
Mecynocera clausii																	1		1
Microsetella sp.	1	1	4	4	5			1					1						17
* Oncaea sp.		2	20		7							1		2	2	4			38
Oithona sp.	96	14	6	1	4	3	22				1	45	38		2	83	47		362
Phaenna spinifera								1		2									3
* Pleuromamma abdominalis							19				1	1			1				22
* Pontella atlantica						3		2											5
Pontellopsis sp.						4													4
Sapphirina sp.								8				1							9
Scolecithrix danae								1											1
Temora stylifera			2			3	7			1	110	100	13	5		3	16		270
Copepida sp.	92	48	103	34	28	31	49	110	4	30	33	16	12	21	4	33	54	62	764
Copepoda larvae		100	168	25	61														354
Ostracoda																			
* Conchecia sp.							1	5		2		3		2		17	12	1	43
Mallacostraca																			
Amphipoda (unidentified spp.)						1		9		2	4		2		1	2		1	23
Decapoda	1					5	1					2			3			7	19
Lucifer sp.							1	2			3	4	30	2					42
Maia sp.							1						1				1		3
Pelagithura sp.										2									2
* Sergestes sp.						1	1				1		1				1		5
* Euphausiacea (unidentified spp.)						30	4	29		6		4	11	1	1	4	17	3	110
* Mysidacea (unidentified spp.)						10	2						32	9	3	1	2		59
Stomatapoda (larvae)													3		4				7

STA. NO.	1	2	3	4	5	25	488	514	538	539	585	586	612	613	638	673	695	1241	TOTAL
MOLLUSCA																			
Heteropoda																			
Atlanta sp.											1								1
Pteropoda (unidentified sp.)	2					50	6	3		4	17	65	66	130	45		169	7	564
Cavolina sp.			2																2
Creseis sp.			1				5	1		2	6		1	11			2		29
Hyalocylus sp.													4						4
Limacina sp.			15		2											18			35
Spiratella sp.			3											1					4
Lamellobranchiata (unidentified)	2		24																26
CHAETOGNATHA (unidentified spp.)		4	11	1		1	2	11		4	10	2	2	10			16	7	81
ECTOPROCTA (Cyphonautes larvae)	1																		1
PHORONIDEA (Phoronis larvae)						1	1												2
ECHINODERMATA																			
Auricularian larvae																1	4		5
Pluteus larvae						52	1	10	1	2	39	33	158	115			4	72	487
Unidentified larvae		3	4		5														12
PROTOCHORDATA																			
Hemichordata																			
Tornaria larvae						2				1			2	1	2	7			15
* Larvacea (unidentified sp.)	21	3	1	2	2	2		3				13		2		26	20		95
Thalliacea																			
* Salpa sp.						3	12	10		1	1		7		1				35
* Doliolum sp.	1				1		1	1			4	1	1				2		12
Unidentified invert. larvae						34	4	2	1	1	5	5	2	1	1	12	21	3	92
CHORDATA																			
Pisces																			
Caecula imberbis								1			399								400
Trachurus trachurus											1		542			638	938	1376	3495
Unidentified larvae								381					1	465		1			467
Unidentified ova	1331			1		394	662	9	8	98	1	560		2	88		3	88	3245
* BIOLUMINESCENT WHEN AGITATED																			

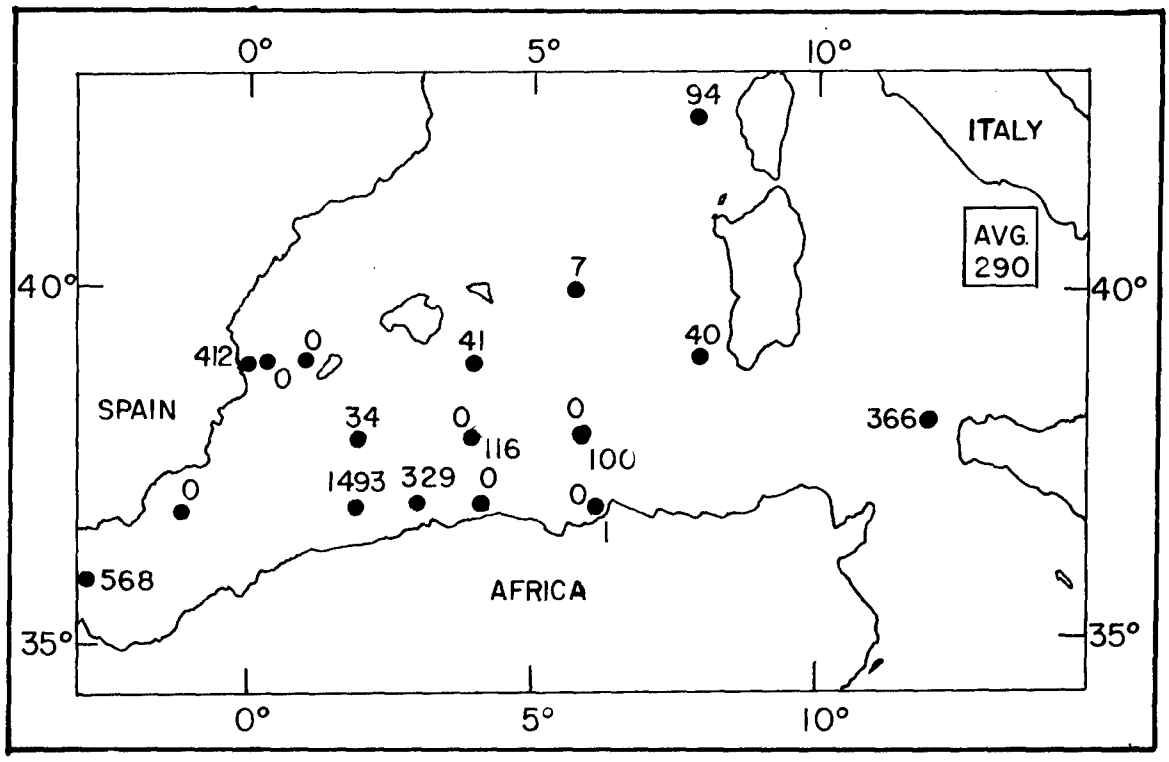

Figure 3. Number of Dinoflagellata - Western Mediterranean

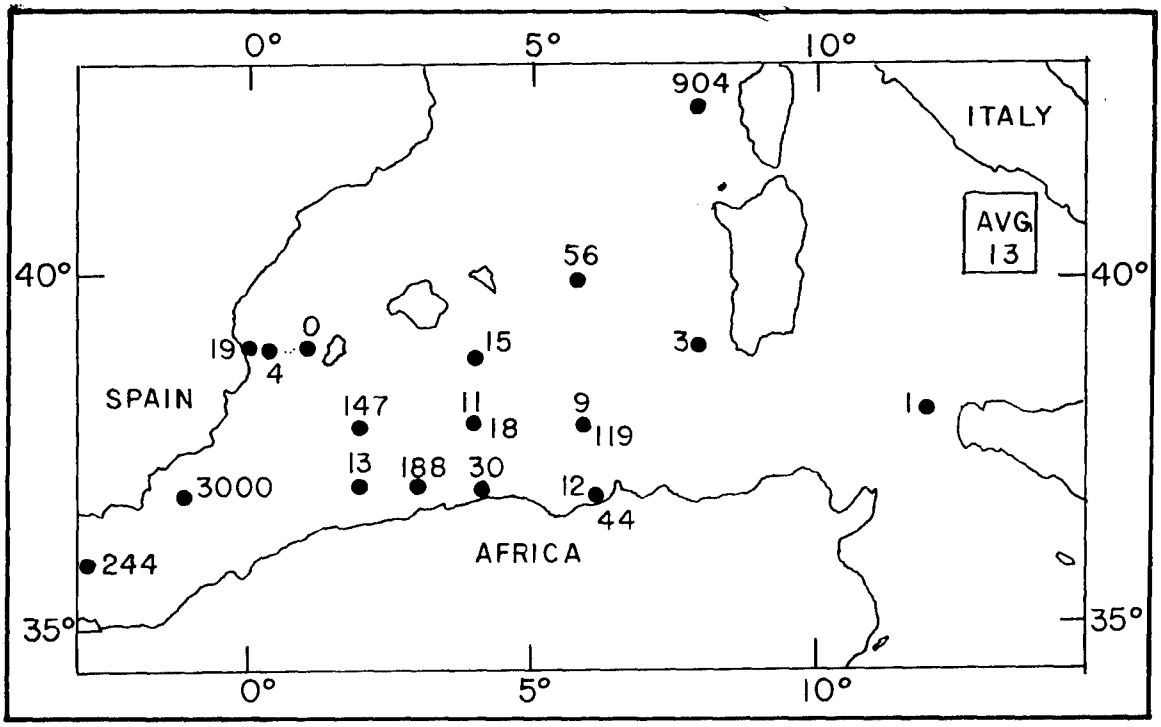

Figure 4. Number of Siphonophora-Western Mediterranean

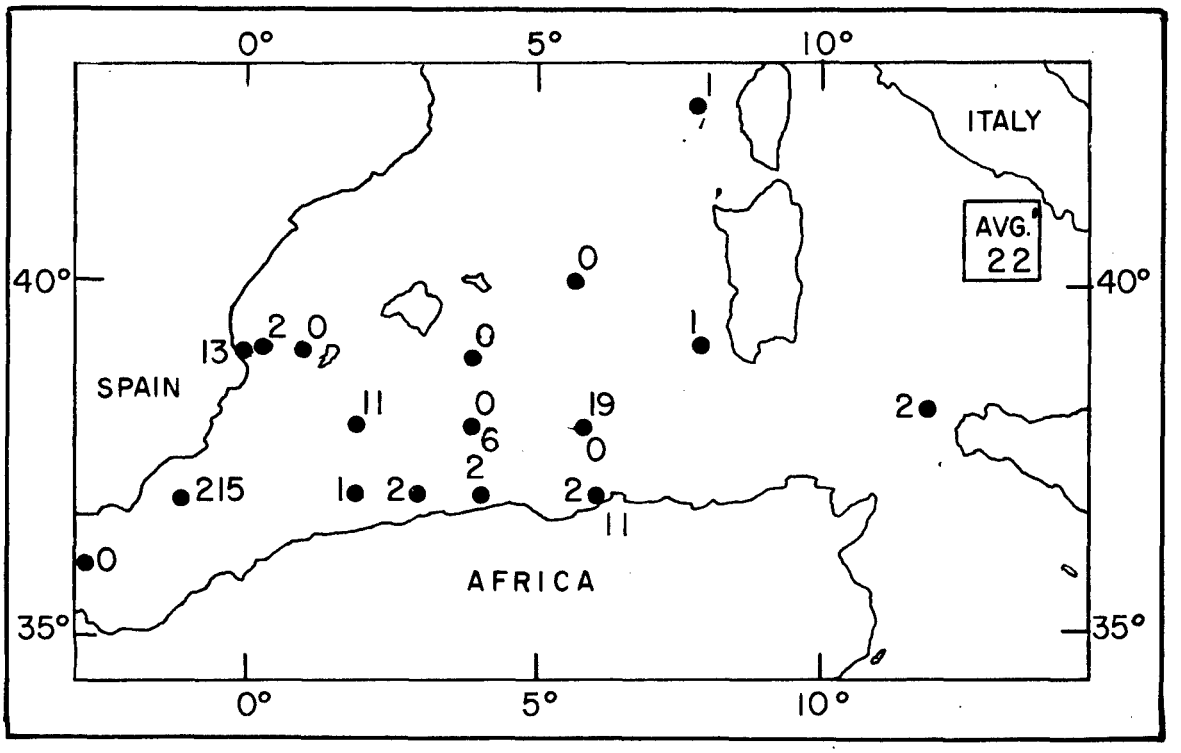

Figure 5. Number of Hydrozoa - Western Mediterranean

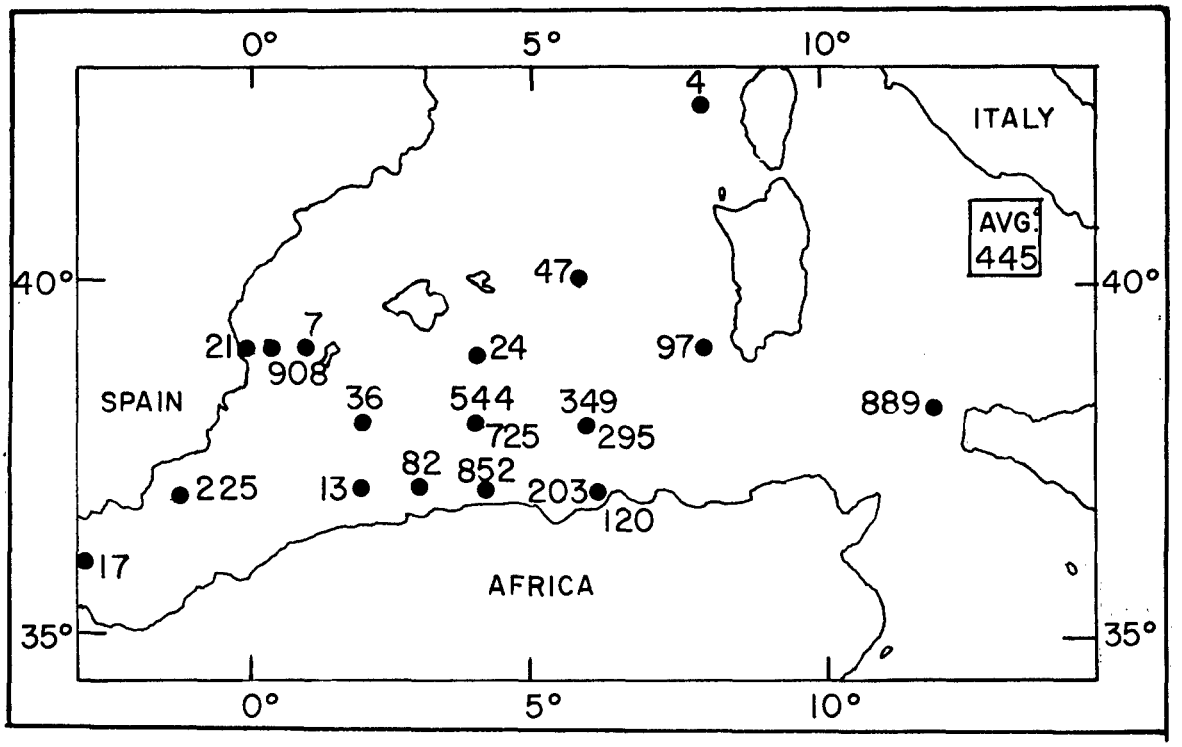

Figure 6. Number of Copepoda - Western Mediterranean

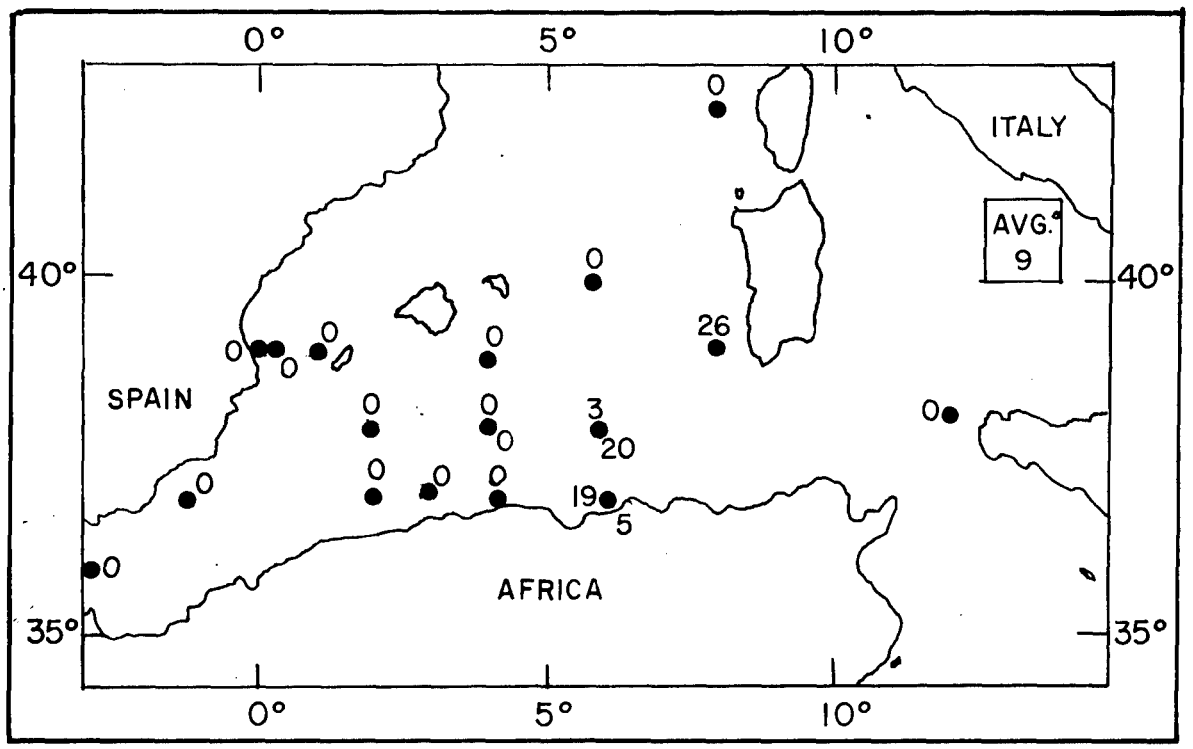

Figure 7. Number of Ostracoda - Western Mediterranean

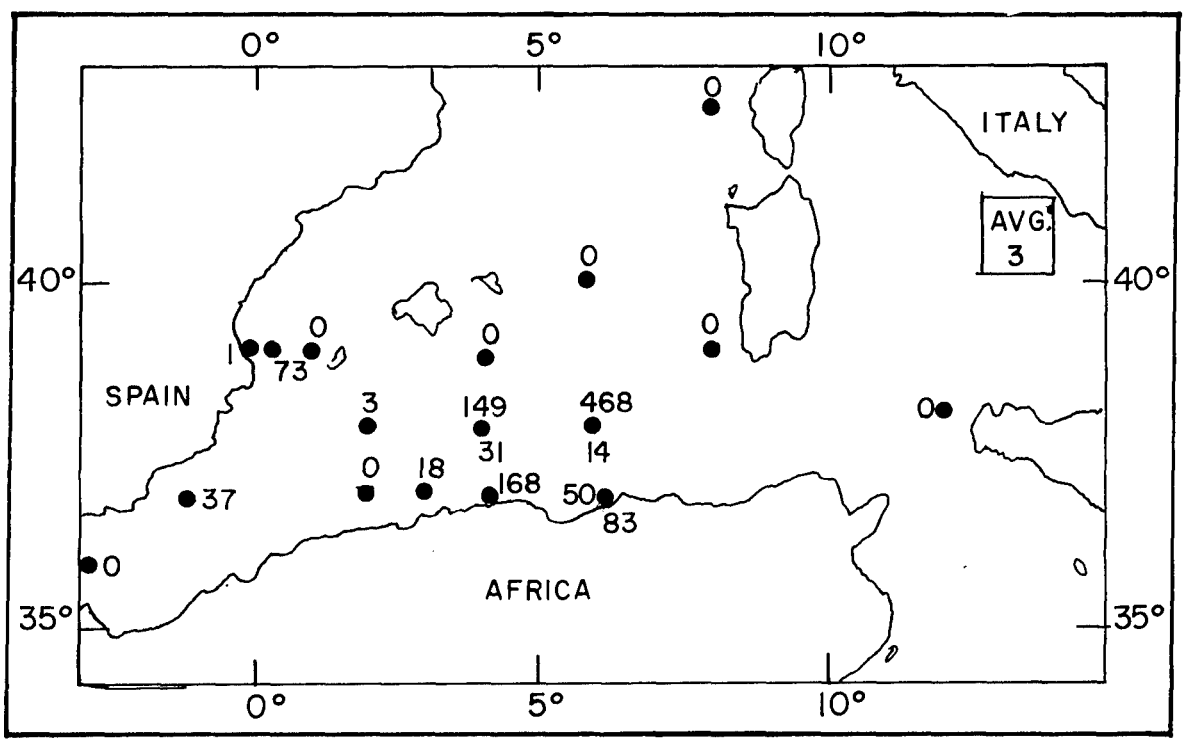

Figure 8. Number of Euphausiacea - Western Mediterranean

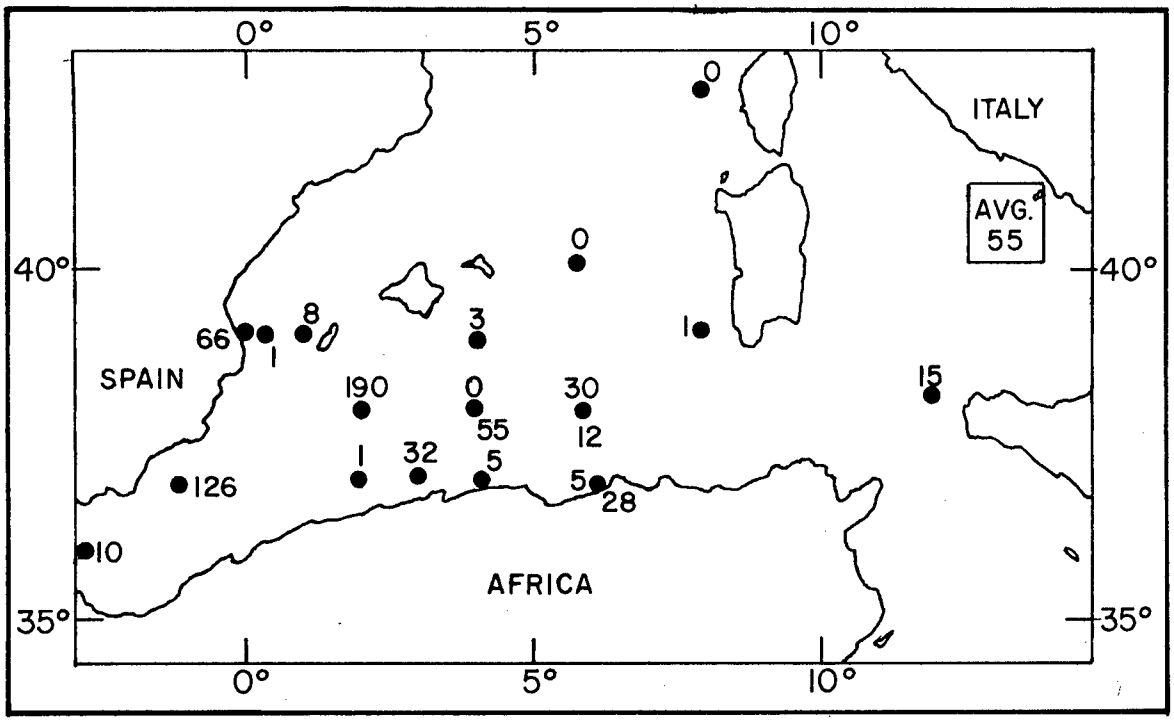

Figure 9. Number of Mollusca - Western Mediterranean

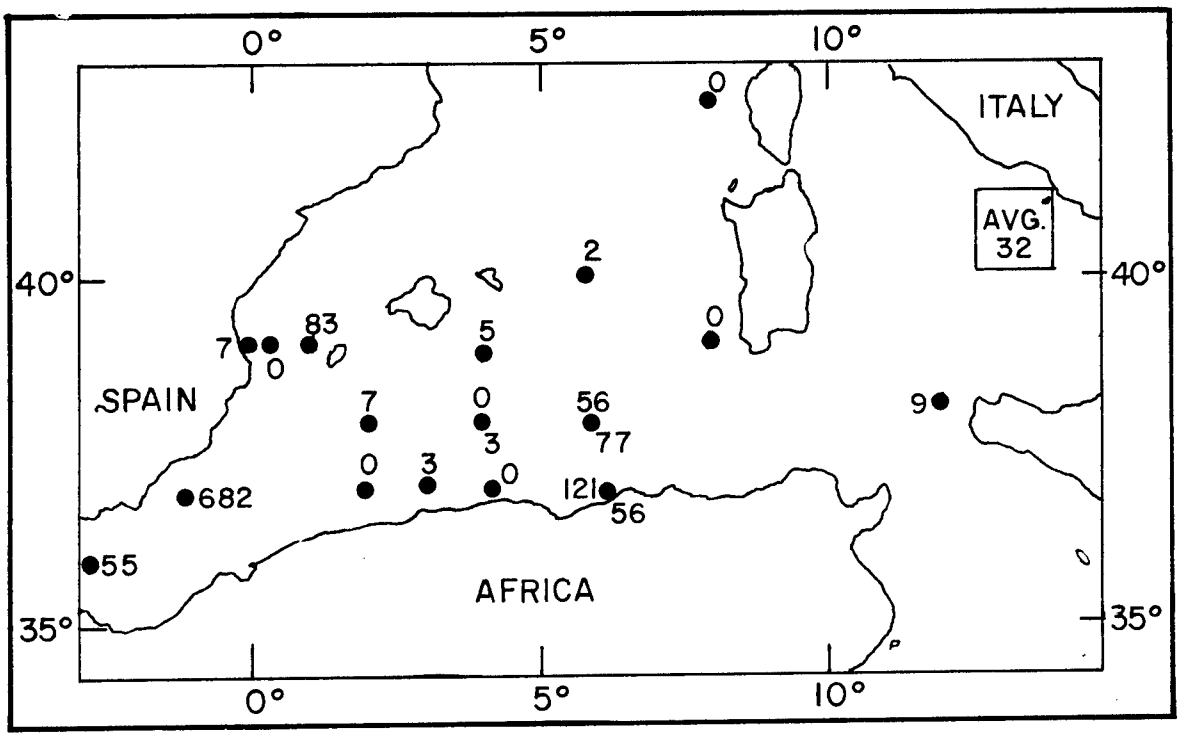

Figure 10. Number of Chaetognatha - Western Mediterranean

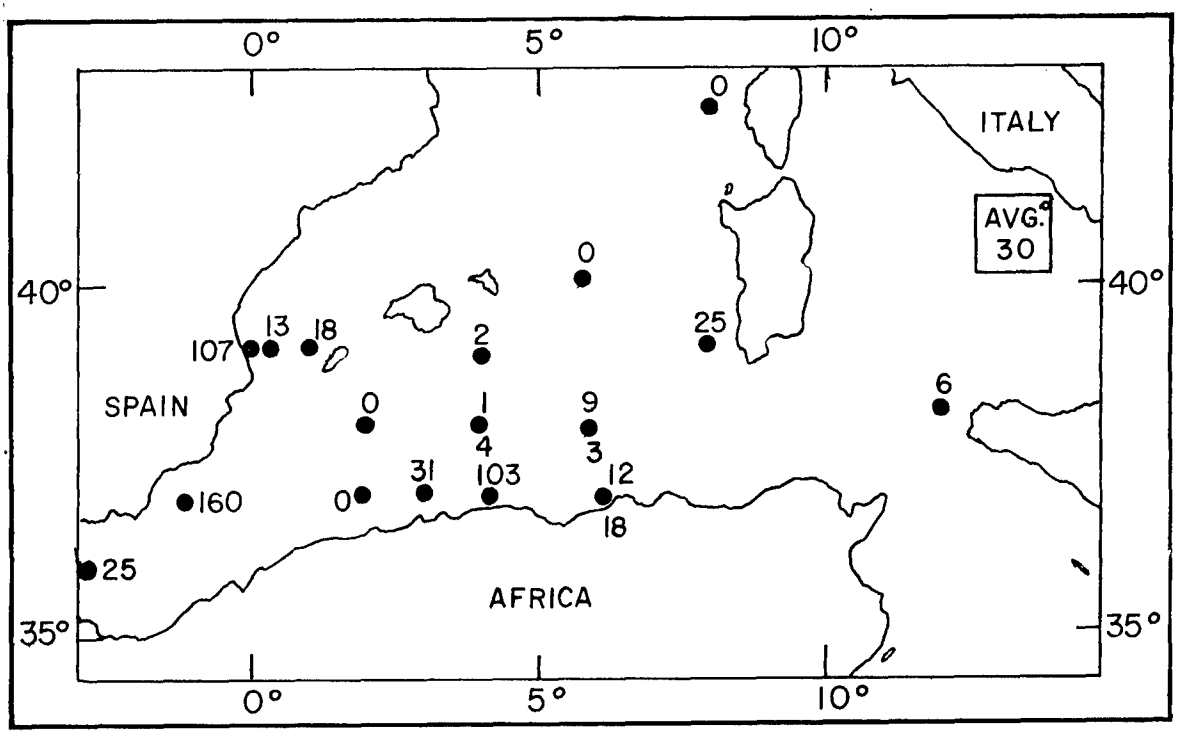

Figure 11. Number of Urochordata - Western Mediterranean

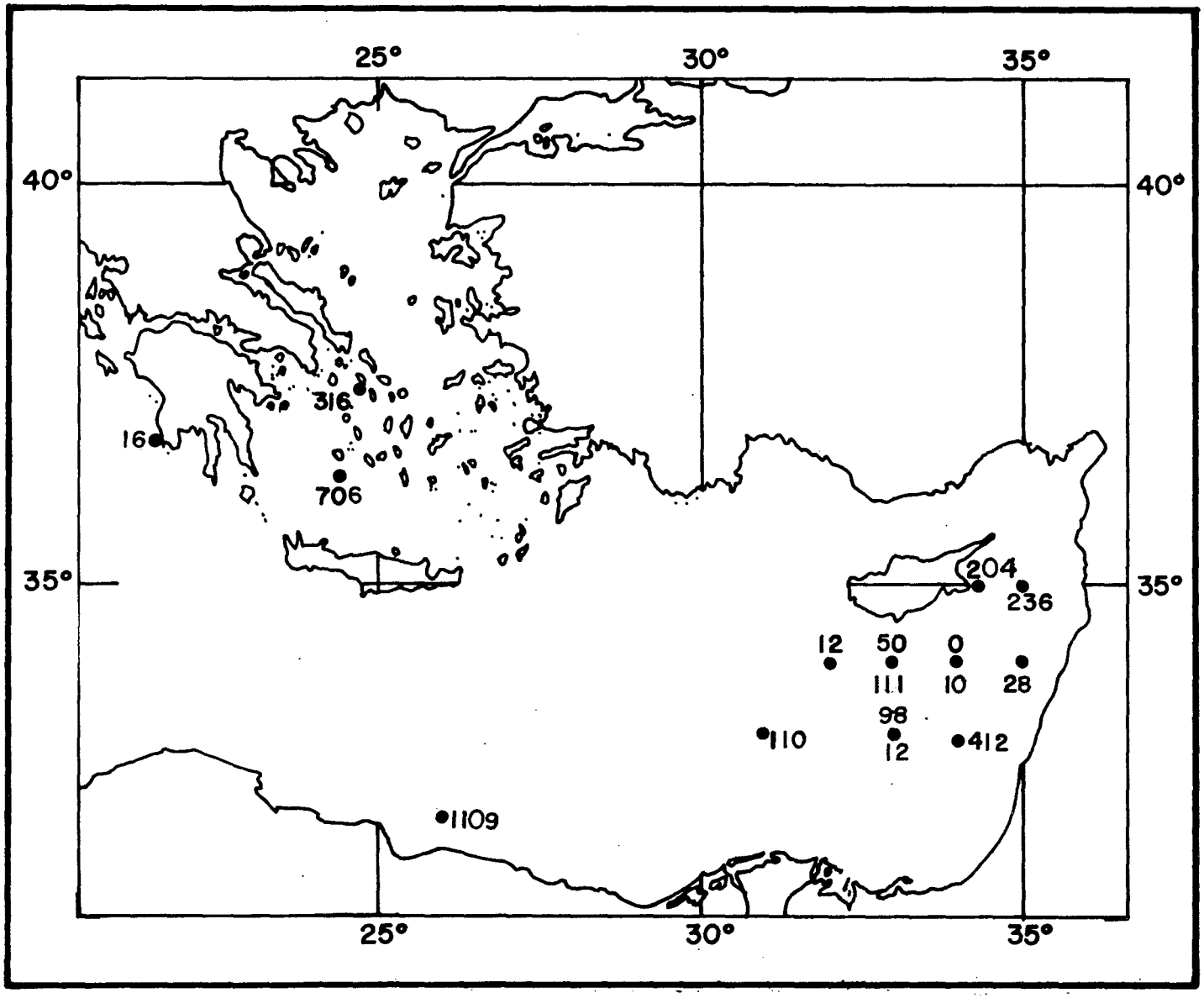

Figure 12. Number of Dinoflagellata - Eastern Mediterranean

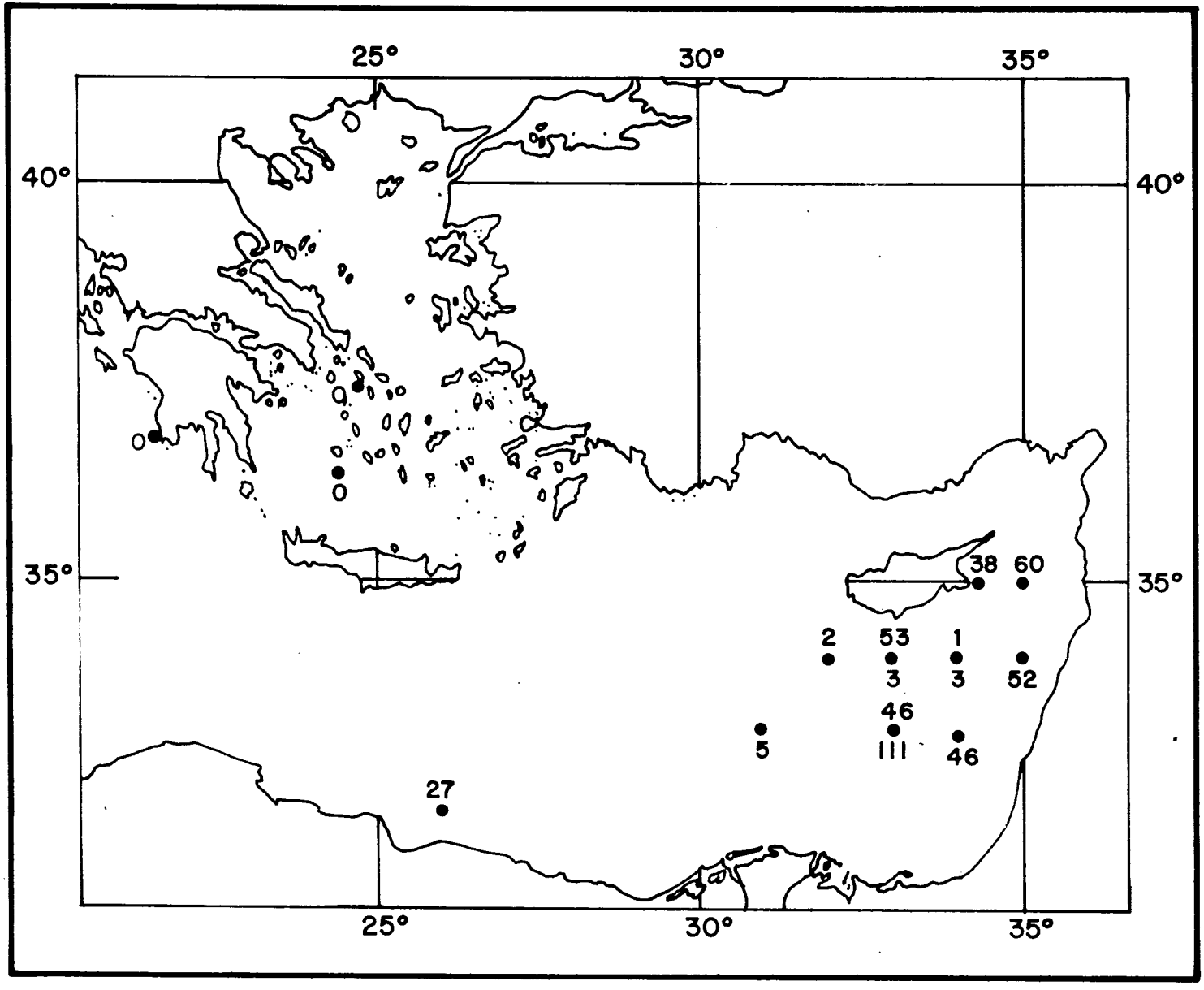

Figure 13. Number of Siphonophora - Eastern Mediterranean

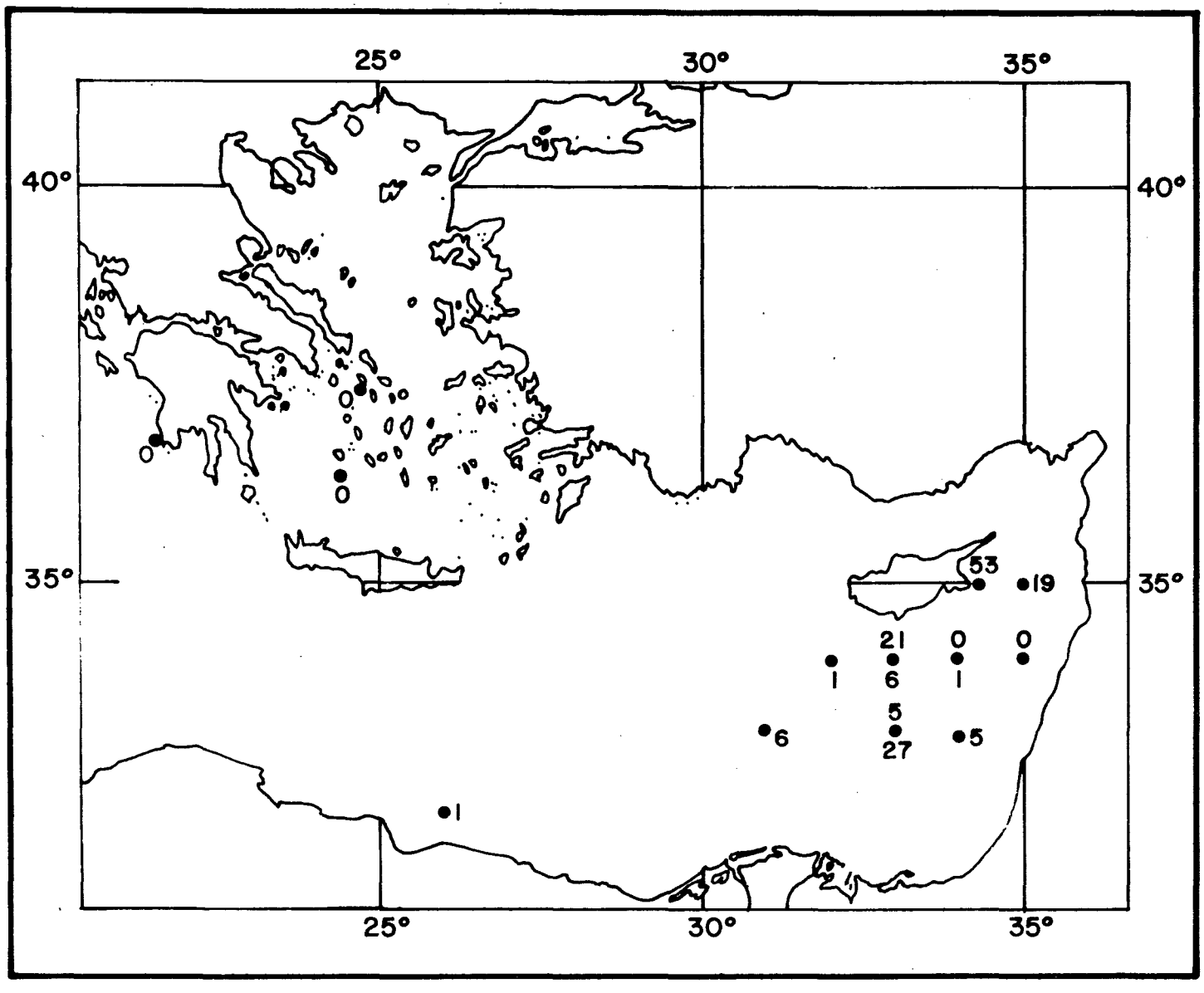

Figure 14. Number of Hydroza – Eastern Mediterranean

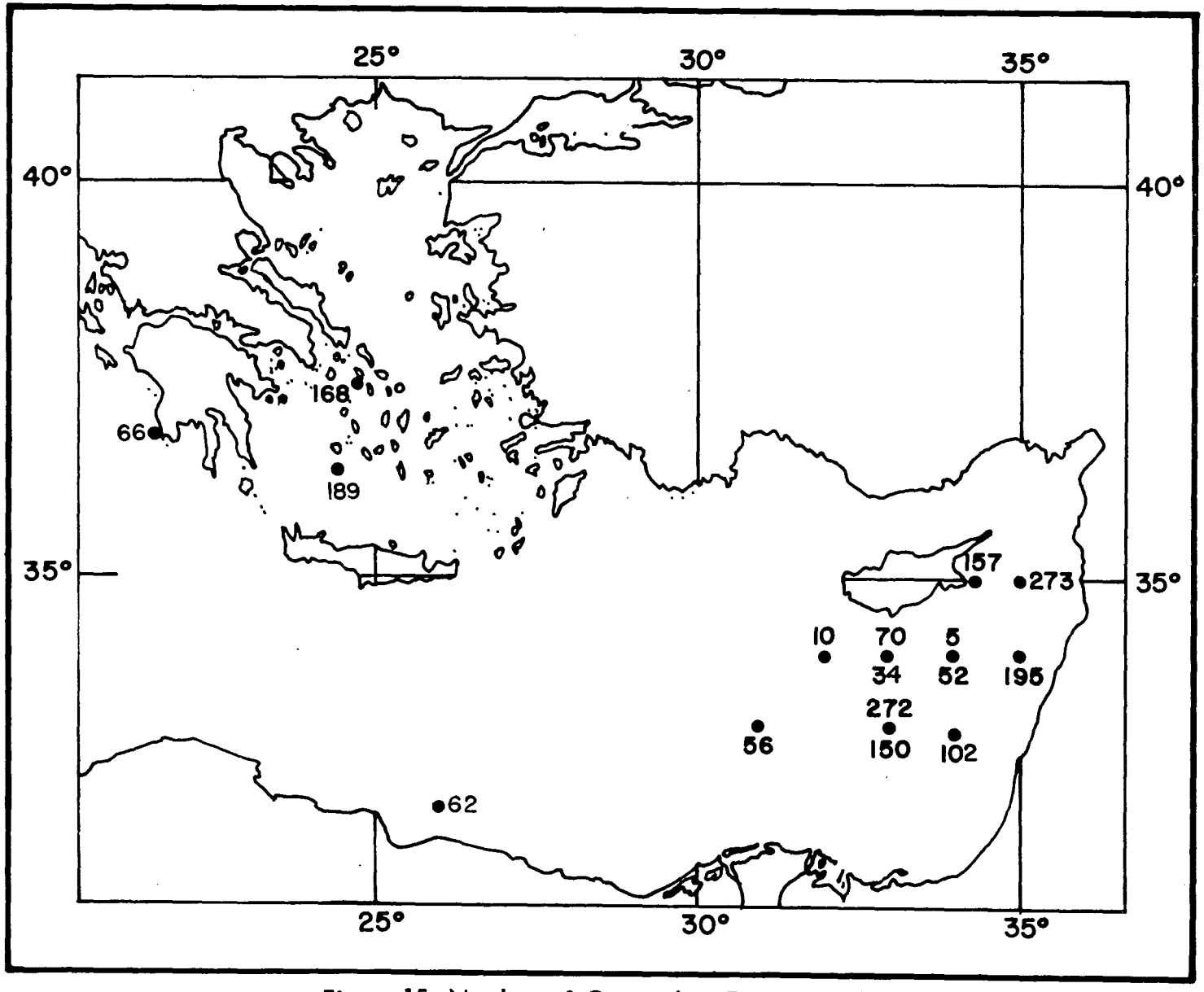

Figure 15. Number of Copepoda - Eastern Mediterranean

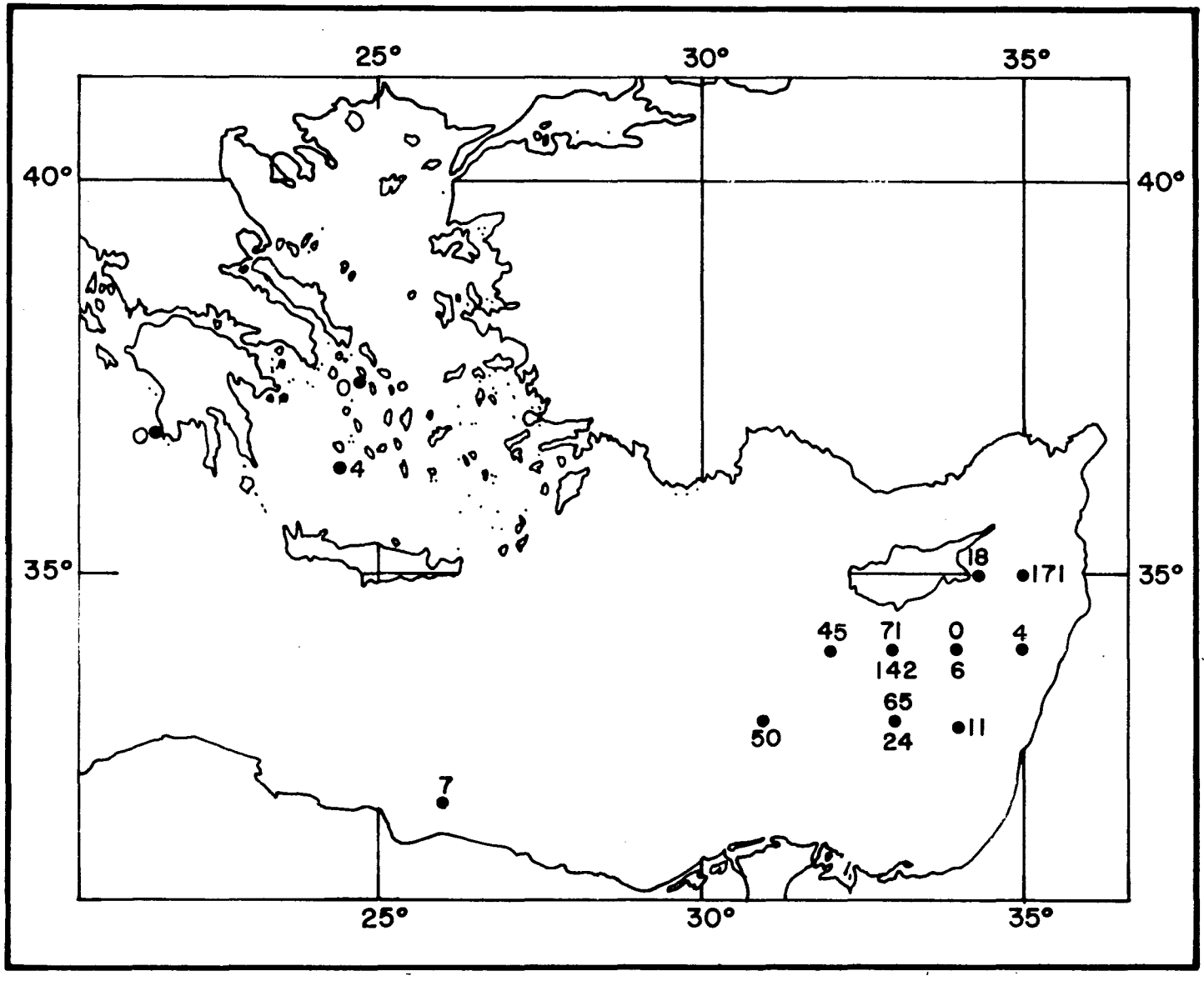

Figure 16. Number of Mollusca – Eastern Mediterranean

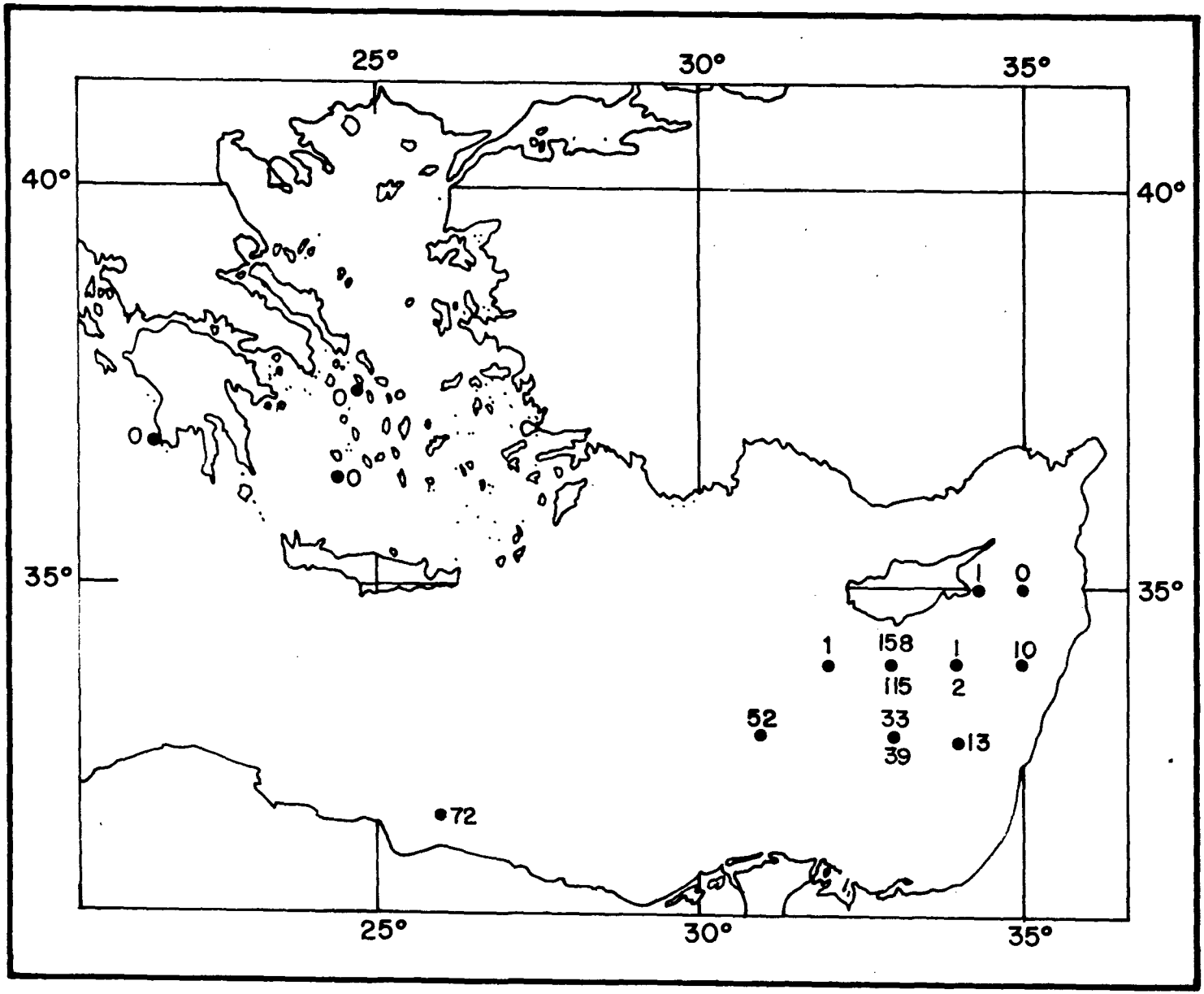

Figure 17. Number of Echinodermata - Eastern Mediterranean

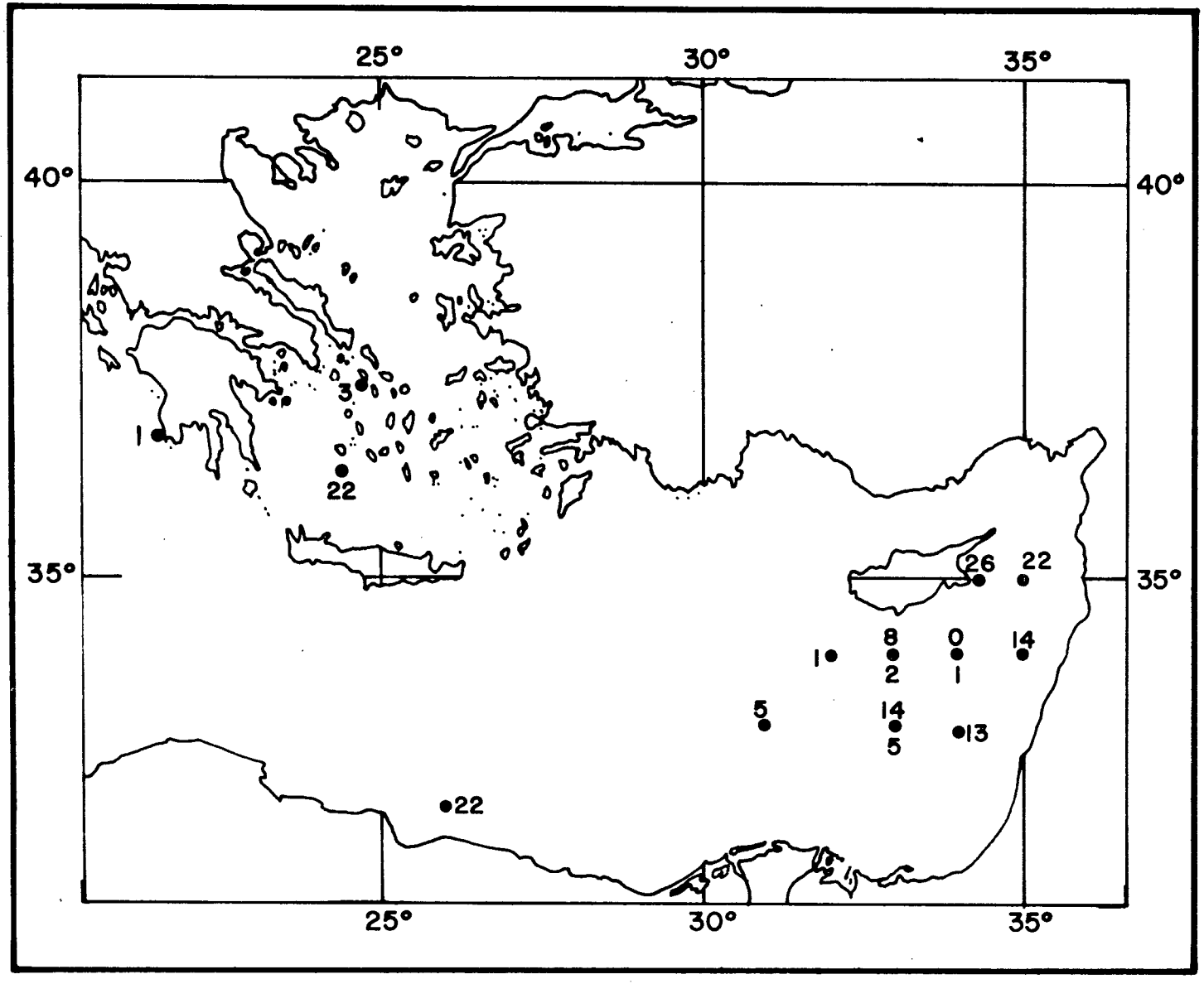

Figure 18. Number of Urochordata - Eastern Mediterranean

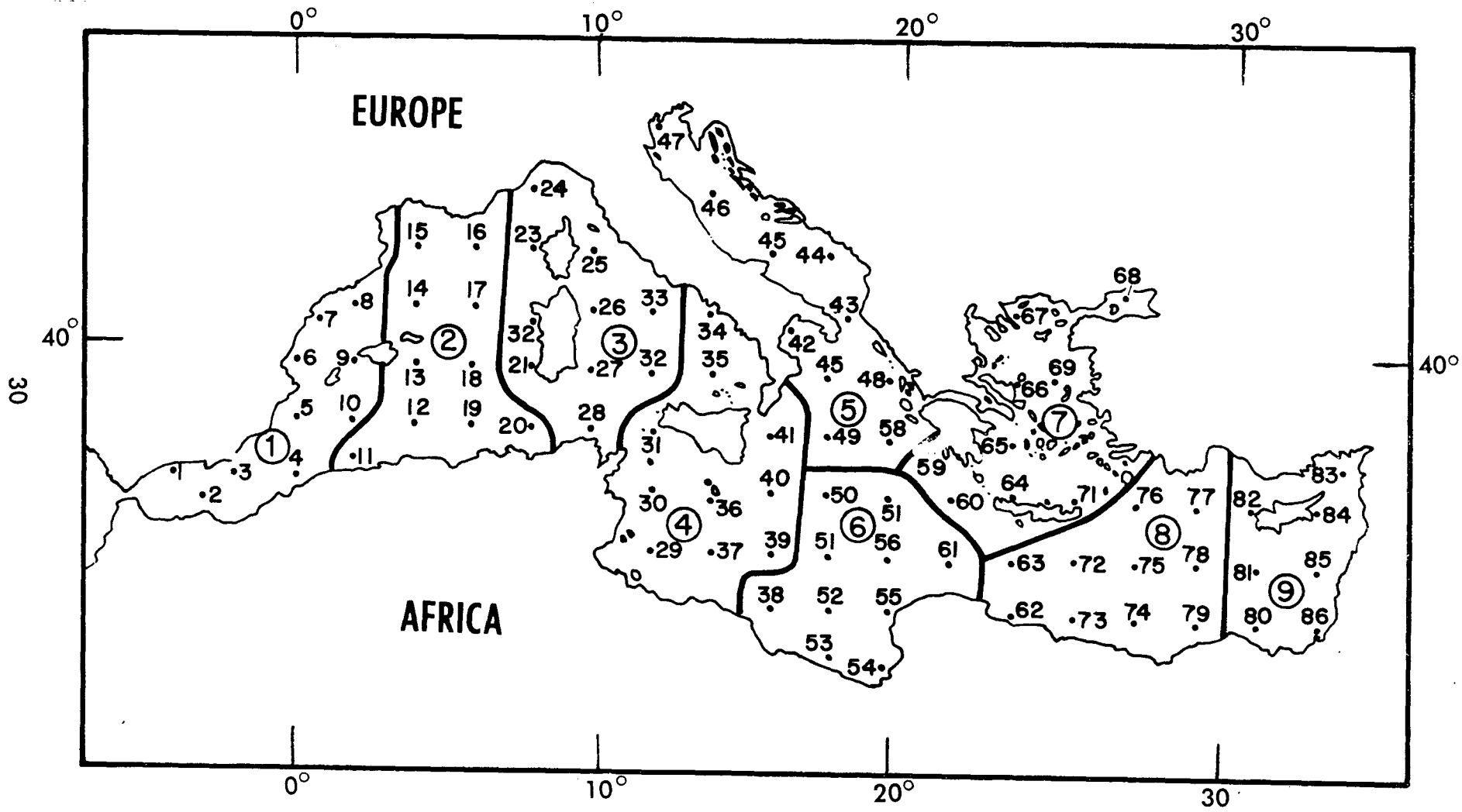

Figure 19. Proposed Station Locations in the Mediterranean

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

Naval Oceanographic Office ships collected 34 plankton samples in the Mediterranean between 6 July 1962 and 24 August 1963. Species composition was quite similar throughout the sea. Ninety-four genera of plankters were identified from the western sector and 84 genera from the eastern sector. Seven of 11 major taxa were two to ten times more numerous in the western portion of the sea and only two of these taxa proved more numerous in the eastern portion. About 20 percent of the forms listed were bioluminescent. Many plankters enter the Mediterranean from the Atlantic through the Strait of Gibraltar and are swept eastward by the prevailing currents, becoming progressively scarcer towards the eastern sector of the sea.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
PLANKTON MEDITERRANEAN SEA						